(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 May 2001 (31.05.2001)

PCT

(10) International Publication Number
WO 01/39167 A1

(51) International Patent Classification[7]: G09G 3/36, G06F 1/32

(21) International Application Number: PCT/SE00/02179

(22) International Filing Date:
8 November 2000 (08.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
9904271-5 25 November 1999 (25.11.1999) SE

(71) Applicant: TELEFONAKTIEBOLAGET LM ERICSSON (publ) [SE/SE]; S-126 25 Stockholm (SE).

(72) Inventor: LUTNAES, Sturla; Ulleråkersvägen 64, S-746 43 Uppsala (SE).

(74) Agents: HEDBERG, Åke et al.; Aros Patent AB, P.O. Box 1544, S-751 45 Uppsala (SE).

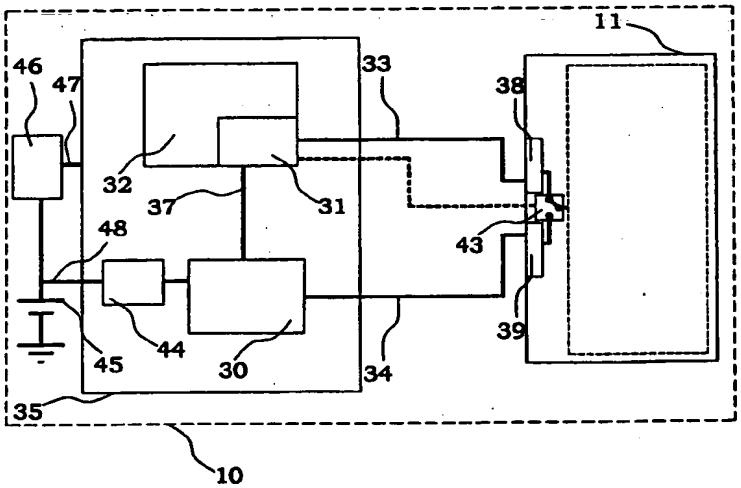
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DISPLAY SYSTEM



(57) Abstract: According to the present invention, in an electronics device having a display unit (11), the display unit (11) comprises according to the present invention at least two interfaces (38, 39), controlled by one display control unit (30, 31) each. The electronics device comprises further an arbitrator (42), resolving any access conflicts between the interfaces (30, 31). The arbitrator (42) can be implemented as a switching means in the display unit or as a software communication between the display control units. The interfaces (30; 31) preferably control mutually overlapping areas (40, 41) of the display unit (11). One of the interfaces (39) may be slow, and accessed e.g. by a serial connection, being responsible for the information display during stand-by or inactivity periods, when only limited information display is needed. During such periods, the display control device (31) for the other interface (38) and associated circuitry are preferably turned off. The other interface (38) is preferably of a fast type, accessed by e.g. a parallel connection, being responsible for a full utilization of the display unit (11).

WO 01/39167 A1

DISPLAY SYSTEM

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to electronic display devices and in particular to liquid crystal displays in portable electronics equipment.

DESCRIPTION OF RELATED ART

The general trend in telecommunication and computer devices today is the struggle to reduce the size, reduce the power requirement and increase the mobility of the devices. Portable electronic devices, such as portable computers, mobile and cordless telephones, become more common and may comprise more and more processing capacity. One common problem with such devices is the supply of electric power. Due to the mobility, the power supply has to rely on batteries or any kind of cordless energy transmission, e.g. solar cells. Batteries are normally relatively bulky and heavy, and even with the latest battery development, the operation time of the devices is quite limited before a recharging of the batteries is necessary.

One way to increase the operation time of the batteries is to reduce the need of electric power. Many devices and methods for reducing the power required during active use of the device are available. Another part for saving power is to reduce the power need during stand-by or inactivity periods. One large power consumer in a typical portable electronic device is the display unit, typically a LCD unit. There are several methods for saving power during inactivity periods, by shutting off displays or parts thereof, or reduce e.g. reducing the illumination strength of the display. Examples of such solutions may be found in the patent documents EP-A 0,811,866, US 5,805,121 and GB-A 2,320,591. In the first document, a part of the LCD display is shut-off during stand-by operation, saving the power need for the actual LCD unit. The second one instead reduces the number of pixels, which also reduces the power need for the LCD unit.

By using devices according to the above-described art, reduces the power need considerably. However, any possible further reduction of the power consumption will be appreciated since it increases the lifetime of a fully charged battery. Since the recent development in telecommunication and computer devices requires display of more and more information, e.g. in mobile telephones for Internet connections or advanced portable computers, the display units are often quite large and the processing power needed to supply the information to be displayed increases. These large display units and the connected processing units require more electric power than e.g. small conventional mobile telephones. Even with the power-reducing methods according to the state of the art, the power consumption of such devices is too high. Therefore, there is a general need to further decrease the power consumption in portable electronics devices.

SUMMARY

A general problem of portable electronics devices with displays according to prior art is a too high power consumption in relation to the requested battery lifetimes.

The general object of the present invention is therefore to reduce the power consumption of electronics devices having information displays. A further object of the present invention is to reduce the power need during stand-by or inactivity periods. Another object of the present invention is to reduce the power consumption of equipment associated with the operation of the display unit, but not necessarily of the display unit itself.

The above objects are achieved by devices and methods according to the enclosed patent claims. In general terms, in an electronics device having a display unit, the display unit comprises according to the present invention at least two interfaces, controlled by one display control unit each. The electronics device comprises further an arbitrator, resolving any access

conflicts between the interfaces. The arbitrator can be implemented as a switching means in the display unit or as a software communication between the display control units. The interfaces preferably control mutually overlapping areas of the display unit. One of the interfaces may be slow, i.e. having a low bandwidth, and accessed e.g. by a serial connection, being responsible for the information display during stand-by or inactivity periods, when only limited information display is needed. During such periods, the display control device for the other interface and associated circuitry are preferably turned off. The other interface is preferably of a fast type, i.e. having a high bandwidth, accessed by e.g. a parallel connection, being responsible for a full utilization of the display unit.

The advantage with the present invention is that power consuming parts used for controlling the display unit in an active mode can be shut off during stand-by or inactivity periods, since the display control then is performed through a less power consuming alternative display control unit, with a separate interface.

Further advantages and features of the present invention will be understood in reading the below detailed description of preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with further objects and advantages thereof, may best be understood by making reference to the following description taken together with the accompanying drawings, in which:

FIG. 1 is an illustrative block diagram of an example of a mobile telephone according to prior art;

FIG. 2 is a block scheme of an embodiment of a display device according to the present invention;

FIG. 3 is a block scheme of another embodiment of a display device according to the present invention;

FIG. 4a is a schematic drawing of a mobile telephone in a folded state;

FIG. 4b is a schematic drawing of a mobile telephone in an open state;

FIG. 4c is a schematic drawing of a part of the mobile telephone shown in fig. 4a and 4b;

FIG. 5 is a schematic drawing of mobile telephone according to the present invention;

FIG. 6 is a schematic drawing of a portable computer according to the present invention; and

FIG. 7 is a schematic drawing of a display unit according to the present invention;

FIG. 8 is a flow diagram illustrating a display control method according to the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

First, devices according to prior art are going to be discussed, in order to clarify the characterizing features of the present invention presented later. In fig. 1, an example of a mobile telephone according to prior art is illustrated schematically. This mobile telephone is equipped to enable e.g. connection to an Internet network. A display device 10 comprises a display unit 11, which is controlled by a display control unit 12, which in this example is a part of a central processing unit (CPU) 13. The display control unit 12 is connected with an interface 14 of the display unit via a connection 15. The CPU 13 is used for processing the large information amounts necessary for e.g. the Internet access. The CPU 13 is connected to memory devices 20, 21 such as random access memories. In order to communicate with any telecommunication network, the telephone is equipped with a radio unit 18 and an antenna 19 for transmitting and receiving radio signals. The radio unit is connected to a base band controller 17, which in turn is connected to the CPU 13. The interface 14 may be of different kinds, e.g. partial screen solution, where an active part of the display 16 may be changed from time to time, depending on the present mode of operation.

In such a device, there are four main objects requiring electrical power; the radio unit 18, the base band controller 17, the CPU 13 with accessories and the display unit 11. The reduction of the power consumption of the display 11 is well developed, e.g. by using partial screen solutions etc. The power consumption of the radio unit 18 is mainly determined by the efficiency in antenna functions, which will not be further discussed here. The base band controller 17 has quite limited power consumption and does not require immediate attention. However, the CPU, in particular for devices equipped for advanced tasks such as Internet access, requires a lot of electric power. In order to reduce the total power consumption, the CPU is shut-off during e.g. stand-by periods. However, in order to maintain a few simple information presentations, such as e.g. time, date, signal strength and/or battery charge status, the display unit has to be activated regularly. This updating of the stand-by information is normally performed by starting-up the CPU unit 13, deliver necessary information to the display interface 14 and turn off the CPU 13 again. However, such procedures normally also involves e.g. the memories 20, 21, which all together costs unreasonable amounts of power.

The basic idea of the present invention is to provide an extra interface and control unit to the display unit in order to be able to have a display access requiring less power. This idea is applicable to all types of display-provided electronics devices having an active mode with intensive display operation and a stand-by mode with a sparse display operation. In order to achieve this, the display unit has to be provided with at least two interfaces. LCD units exist today, which enables a selection to use the interface either as a serial or as a parallel interface, but these interfaces are mutually exclusive since the choice of interface is performed upon physically connecting the hardware.

In fig. 2, an embodiment of a display device 10 according to the present invention is illustrated. The display device 10 comprises a display unit 11, preferably a LCD (liquid crystal display) unit. The display unit 11 comprises

a first interface 39 and a second interface 38. The first interface 39 is connected to a first display control unit 30 via a first display connection 34 and the second interface 38 is connected to a second display control unit 31 via a second display connection 33. The second display control unit 31 is in the present embodiment implemented as a part of a central processing unit (CPU) 32. The control units 30, 31 are preferably implemented by microprocessors. The CPU 32 and the first display control unit 30 are interconnected with an interconnection 37, and are both parts of the same processing unit 35, although being independently operable parts. The first display control unit is supplied with stand-by information via a connection 36. The origin of such stand-by information could be within the processing unit 35, within the display device 10 or from an external source.

The first interface 39 of the display unit 11 is arranged for operating the display unit 11 in a first display mode, accessing a first display area 41 of the display. The second interface 38 of the display unit 11 is similarly arranged for operating the display unit 11 in a second display mode, accessing a second display area 40 of the display. The first display area 41 and the second display area 40 are mutually overlapping, and preferably, the first display area 41 constitutes a sub-area of the second display area 40.

Since each of the interfaces 38, 39 has its own display control unit 31, 30, there might be a conflict in accessing the display unit 11. In order to resolve such conflicts, an arbitrator 42 is provided. The arbitrator 42 is in this embodiment a double switch controlled by the CPU 32.

When a high display activity is needed, the CPU 32 is intensively involved in processing the corresponding data. The second interface 38 is active and the large second display area 40 is used. The arbitrator 42 keeps the display connection 33 closed, and prevent any information flow on display connection 34. Some information may arrive on the stand-by information connection 36, and is treated by the CPU, before being presented at the display through the second interface 38.

When a low-activity or stand-by period occurs, the need for processing power is reduced. The need for a large display area is also reduced, since only a few parameters may be interesting to present. In such a case, the arbitrator 42 turns the responsibility for the display control over to the first display control unit 30 and connects the first interface 39. The CPU 32 and the second display control unit 31 are shut-off in order to reduce the power consumption. During the stand-by period, only some limited stand-by information is received via the connection 36. This stand-by information is received by the first display control unit 30, which updates the display accordingly. This means that during the stand-by period, only the power low-consuming first display control unit 30 is active. When the stand-by period is ended, the CPU 32 is started-up again, and resumes the display control function.

Since the first interface 39 is supposed to be used during low-activity periods. The first display connection 34 may therefore preferably be a serial connection with a relatively low transmission rate, i.e. a low-bandwidth connection. The first display area 41 is also preferably small, thereby reducing also the power need for the display unit. Preferably a partial screen solution may be used. On the other hand, the second interface 38 is supposed to be used during high-activity periods. The demands for transfer of display information are much larger, and the second connection 33 is therefore preferably a parallel connection, offering a high information rate to the display unit, i.e. a high-bandwidth connection. Accordingly, the second display area 40 is preferably larger than the first one 41. Since there is no conflict in driving the display in the two modes, the areas 40, 41 may be mutually overlapping, and preferably the second display area 40 will cover whole the first display area 41, for using the maximum capacity of the display unit.

Fig. 3 illustrates another embodiment of a display device according to the present invention. Similar parts are denoted by the same reference numbers

and are not further discussed. In this embodiment, the stand-by information is exemplified by the status of the power supply of the processing unit 35. A battery 45 is connected to a regulation unit 46, which supplies an operation voltage V_{dd} via a power supply connection 47 to the processing unit. A voltage level connection 48 transfers the voltage level of the battery 45 to an analogue-to-digital converter 44 in the processing unit. The result is transferred over to the first display control unit 30. During high-activity operation, this battery status information is forwarded to the CPU 32.

In the embodiment of fig. 3, the arbitrator is provided as a switch 43 at the display unit 11. The switch is alternately connecting either of the interfaces 38, 39. The switch is preferably software controlled by e.g. the CPU 32 or the first display control unit 30.

The above described display devices are with advantage used in different portable electronics devices. Fig. 4a-c schematically illustrates a mobile telephone 50 with functionality to Internet access. In fig. 4a, the telephone 50 is illustrated in a folded configuration, where a base unit 51 is partially covered by a lid 52. A display device 53 is arranged at the front side of the base unit 51. When the lid 52 is folded over the base unit 51, as illustrated in fig. 4a, only a minor first part 54 of the display is visible. In such a configuration, the telephone may be used as an ordinary mobile telephone, and the first part 54 of the display unit displays necessary information. In fig. 4b, the telephone 50 is folded up, by turning the lid 52 away from the base unit 51. The whole display area 55 of the display device 53 is visible and is available for displaying e.g. Internet information. In fig. 4c, the display part of the telephone illustrated in fig. 4a and 4b is shown. In this figure, the first part area 54 and the whole display area are drawn together, pointing out the difference in display requests. Such a telephone will greatly benefit from a display device according to the present invention.

In fig. 5, a sketch of a mobile telephone according to the present invention is illustrated. Similar parts as in earlier described display devices have the

same reference numbers and are not further discussed. The base band controller 17 is provided with a first display control unit 30, connected by a first display connection 34 to a first interface 39 controlling a first area 54 of the display 11. The CPU 13 is as before provided with a second display control unit 31, connected by a second display connection 33 to a second interface 38 controlling a second area 55 of the display 11. The arbitrator 60 is in this embodiment implemented as a software communication over the interconnection between the base band controller 17 and the CPU 13, handling the access rights to the interfaces 38, 39.

When the mobile telephone is operated in the Internet mode, the CPU 13 is fully utilized, the second display control unit 31 has the control over the display 11 according to the arbitrator 60 communication. The full screen is operable. When the mobile telephone is folded up and put in a stand-by mode, the only information normally displayed is the signal strength, the status of the battery charge and the time and date. The base band controller readily provides this information. The CPU 13 is accordingly shut-off, and the arbitrator 60 hands over the display control to the first display control unit 30. Such a shut-off of the main CPU 13 at inactivity periods is known in prior art. The smaller first area 54 at the display 11 is now available for the limited information necessary and the power consumption of the CPU 13 and the memories 20, 21 is now totally avoided.

Comparing the telephones of fig. 1 and fig. 5 will clearly point out the essence of the present invention. The display is provided with two interfaces, which are driven by two independent display control units 30, 31. One unit 31 is associated with a power-consuming high-activity processing unit 13, and has access to a large display area 55. The other 30 is independent of the power-consuming high-activity processing unit 13 and may therefore drive a smaller area 54 during low-activity periods, hence reducing power consumption and prolonging battery life.

Fig. 6 illustrates another interesting device, which advantageously is provided with a display device according to the present invention. A portable computer 70 comprises a bottom part 72 and a top part 71, which are foldable against each other. The bottom part 72 is provided with keys, mouse functions etc. according to prior art. The top part is provided with a large LCD screen 73. During normal operation, the whole screen area 74 is normally used to display necessary information. The computer and the display operate in a high consuming power mode. However, during inactivity periods, the only information that normally has to be updated is the time and battery charge indicator, located in a limited screen area 75. In such a state, the main processors may be turned off, saving power, while a simple power low-consuming display control is made responsible for the update of the stand-by information.

Fig. 7 schematically illustrates a preferred embodiment of a display unit according to the present invention. A LCD unit 11 comprises a LCD area 53. A row driver 82 and a column driver 81 control the LCD area 53. The column driver is comprised in a driver control unit 80. A first interface 39 and a second interface 38 are the inputs of the driver control unit 80. The driver control unit further comprises a control block 89 and a display RAM 90. The first interface 39 is in this embodiment constituted as a serial interface, having a serial data input/output connection 83 and a serial clock connection 84. The second interface 38 is in this embodiment constituted as a parallel interface, having a 16 bit bi-directional data bus 85, a command/data select signal connection 86, a read strobe connection 87 and a write strobe connection 88. The interfaces according to the present invention are thus simultaneously physically connectable, but only operated one at the time. An arbitrator, implemented either in the display unit itself or in associated units, performs this arbitration. In a preferred embodiment, a block 48 within the control block 89 performs the arbitration.

Fig. 8 is a flow diagram illustrating a display control method according to the present invention. The process starts in step 100. In step 102, an arbitration

process is made. Here, it is determined whether the display is going to be driven in a first mode or not. If the first operation mode is to be selected, a first display unit interface is driven in step 104, operating the associated display in the first mode. However, if the first mode is not of interest, a second display unit interface is driven, in step 106, operating the associated display in a second mode. The process is ended in step 108. The illustrated process should not be interpreted as a regular flow diagram, but rather illustrate the alternating access to the two display modes.

As anyone skilled in the art, there are several possible modifications and variants within the scope of the enclosed claims. For instance, the principle of independently operating interfaces may be implemented on more than two interfaces, adjusting the display control to the activity level in several steps. A possible case would be the mobile telephone, earlier described, where a first mode could be a pure stand-by mode, a second mode may be a normal telephone mode and a third mode could be an Internet mode. These modes require different amount of display area and different processing power.

It will be understood by those skilled in the art that various modifications and changes may be made to the present invention without departure from the scope thereof, which is defined by the appended claims.

CLAIMS

1. Display device (10), having a display unit (11; 53; 73), **characterised in that** said display unit (11; 53; 73) comprises a display (53), drivers (81, 82) and at least a first (39) and a second interface (38), both connected to the same drivers (81, 82), said first interface (39) being connected to a first display control unit (30) and said second interface (38) being connected to a second display control unit (31), and an arbitrator (42; 43; 48; 60), arbitrating between said interfaces (38, 39).

2. Display device according to claim 1, **characterised in that** said arbitrator is a software controlled arbitrator (42; 43; 48; 60).

3. Display device according to claim 2, **characterised in that** said arbitrator is a switch (43) at said display unit (11; 53; 73).

4. Display device according to claim 2, **characterised in that** said arbitrator comprises communication means (60) between said display control units (30, 31).

5. Display device according to any of the claims 1 to 4, **characterised in that** said interfaces (38, 39) control mutually overlapping areas (40, 41; 53; 54; 74, 75) on said display unit (11; 53; 73).

6. Display device according to any of the claims 1 to 5, **characterised in that** said first interface (39) is a low bandwidth interface.

7. Display device according to claim 6, **characterised in that** said first interface (39) is a serial interface.

8. Display device according to any of the claims 1 to 7, **characterised in that** said second interface (38) is a high bandwidth interface.

9. Display device according to claim 8, **characterised in that** said second interface (38) is a parallel interface.

10. Display device according to any of the claims 1 to 9, **characterised in that** said second display control unit (31) and associated means are turned off during inactivity periods.

11. Display device according to any of the claims 1 to 10, **characterised in that** at least one of said display control units (30, 31) is implemented by a microprocessor.

12. Display device according to claim 11, **characterised in that** said display control units (30, 31) are implemented as independent means of the same processing unit (35).

13. Display device according to any of the claims 1 to 12, **characterised in that** said display unit (11; 53; 73) is a liquid crystal display.

14. Display device according to any of the claims 1 to 13, **characterised in that** said first interface (39) is arranged for driving said display unit (11; 53; 73) in a partial display mode.

15. Portable electronics device (50, 70), having a display unit (11; 53; 73), **characterised in that** said display unit (11; 53; 73) comprises a display (53), drivers (81, 82) and at least a first (39) and a second interface (38), both connected to the same drivers (81, 82), said first interface (39) being connected to a first display control unit (30) and said second interface (38) being connected to a second display control unit (31), and an arbitrator (42; 43; 48; 60), arbitrating between said interfaces (38, 39).

16. Portable electronics device according to claim 15, **characterised in that** said arbitrator is a software controlled arbitrator (42; 43; 48; 60).

17. Portable electronics device according to claim 16, **characterised in that** said arbitrator is a switch (43) at said display unit.

18. Portable electronics device according to claim 16, **characterised in that** said arbitrator comprises communication means (60) between said display control units (30, 31).

19. Portable electronics device according to any of the claims 15 to 18, **characterised in that** said interfaces (38, 39) control mutually overlapping areas (40, 41; 53, 54; 74, 75) on said display unit (11; 53; 73).

20. Portable electronics device according to any of the claims 15 to 19, **characterised in that** said first interface (39) is low bandwidth interface.

21. Portable electronics device according to claim 20, **characterised in that** said first interface (39) is a serial interface.

22. Portable electronics device according to any of the claims 15 to 21, **characterised in that** said second interface (38) is high bandwidth interface.

23. Portable electronics device according to claim 22, **characterised in that** said second interface (38) is a parallel interface.

24. Portable electronics device according to any of the claims 15 to 23, **characterised in that** said second display control unit (31) is turned off during inactivity periods.

25. Portable electronics device according to any of the claims 15 to 24, **characterised in that** at least one of said display control units (30, 31) is implemented by a microprocessor.

26. Portable electronics device according to claim 25, **characterised in that** said display control units (30, 31) are implemented as independent means of the same processing unit (35).

27. Portable electronics device according to any of the claims 15 to 26, **characterised in that** said display unit (11; 53; 73) is a liquid crystal display.

28. Portable electronics device according to any of the claims 15 to 27, **characterised in that** said first interface (39) is arranged for driving said display unit (11; 53; 73) in a partial display mode.

29. Method of display control, comprising the steps of:

driving a display unit (11; 53; 73), having a display (53) and drivers (81, 82), in a first mode by a first display control means (30) via a first interface (39);

driving said display unit (11; 53; 73) in a second mode by a second display control means (31) via a second interface (38);

arbitrating between said first and second modes.

30. Method according to claim 29, **characterised by** the further step of:

turning off said second display control means (31) when said display unit (11; 53; 73) is driven in said first mode.

31. Method according to claim 29 or 30, **characterised in that** said first and second modes involves mutually overlapping areas (40, 41; 53, 54; 74, 75) on said display unit (11; 53; 73).

32. Method according to claim 29, 30 or 31, **characterised in that** said first mode comprises a partial display mode.

33. Method according to any of the claims 29 to 32, **characterised in that** said step of arbitrating comprises the step of switching from said first mode to

said second mode when said second display control means (31) has been inactive for a predetermined time period.

34. Liquid crystal display unit (11; 53; 73), comprising a display (53) and drivers (81, 82), **characterised by** at least two, simultaneously physically connectable, interfaces (38; 39), both interfaces (38; 39) connected to the same drivers (81, 82).

35. Liquid crystal display according to claim 34, **characterised in that** said interfaces (38; 39) are alternately accessible.

36. Liquid crystal display according to claim 34 or 35, **characterised in that** said interfaces (38; 39) control mutually overlapping liquid crystal display areas (40, 41; 53, 54; 74, 75).

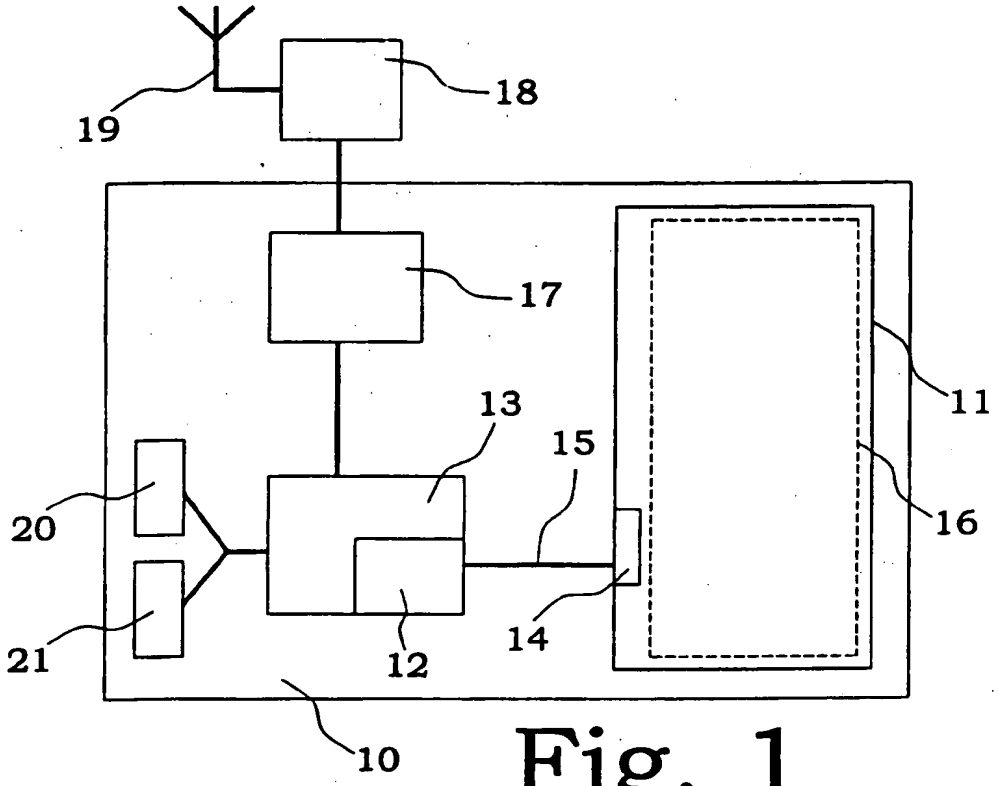

19
18
17
11
13
15
20
16
21
12
14
10

Fig. 1

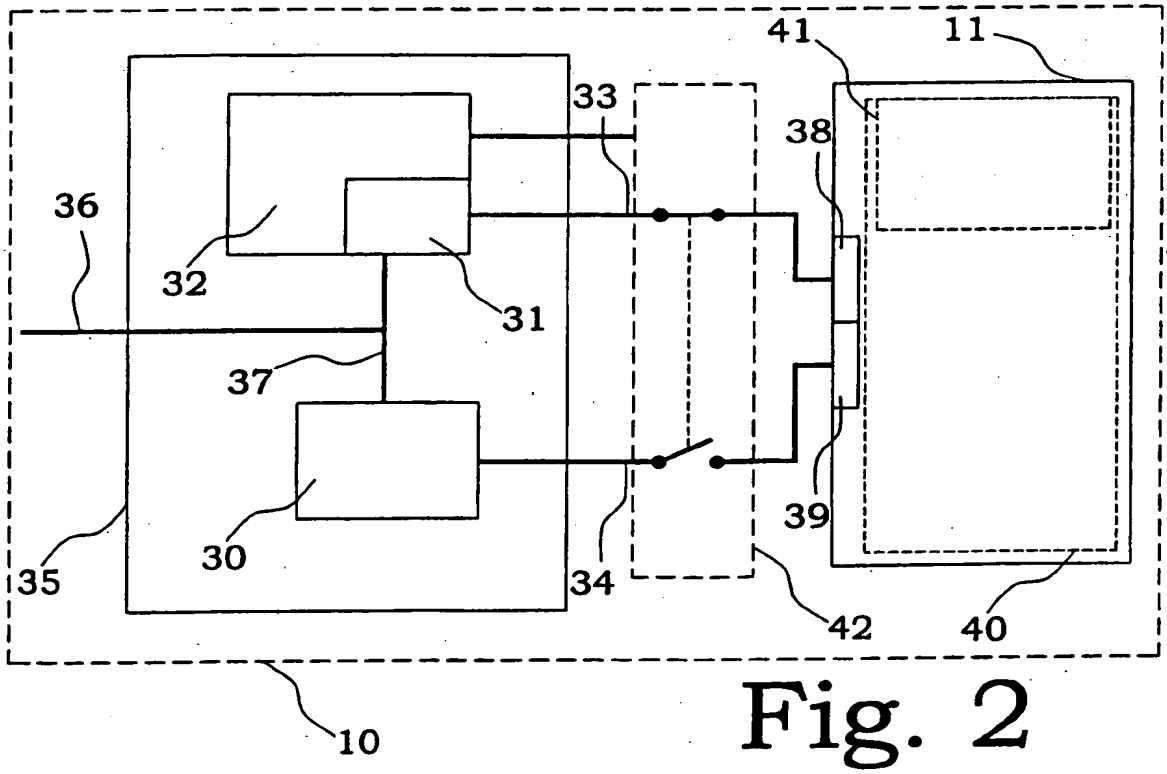

41
11
33
38
36
32
31
37
39
35
30
34
42
40
10

Fig. 2

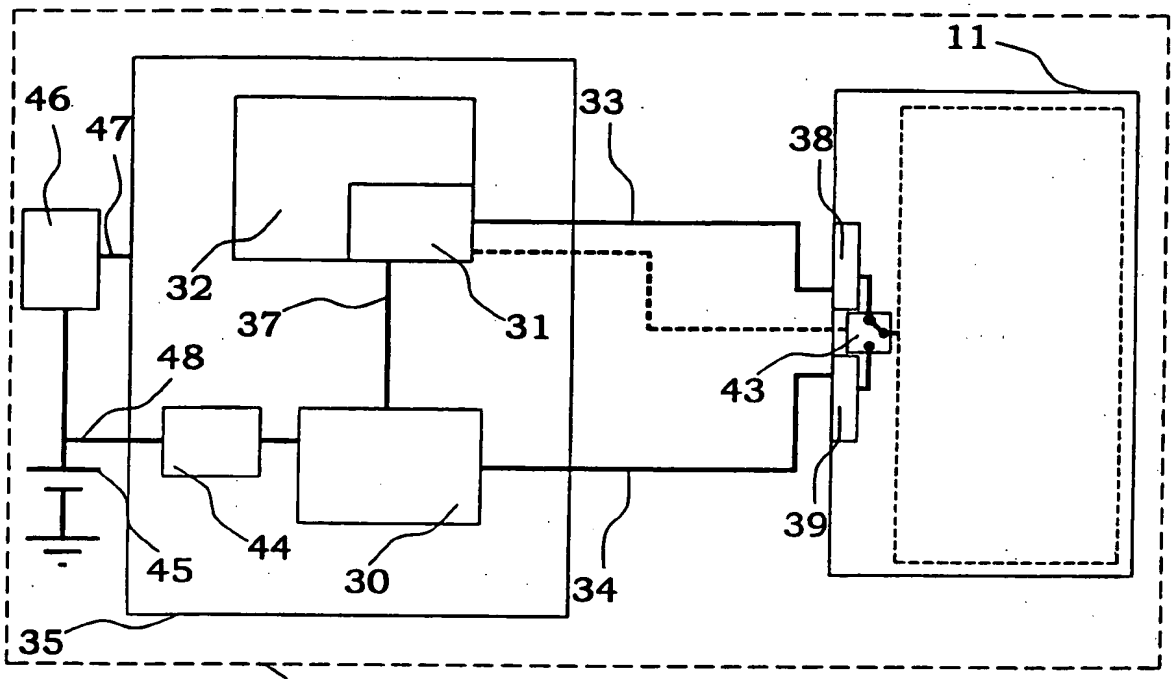


Fig. 3

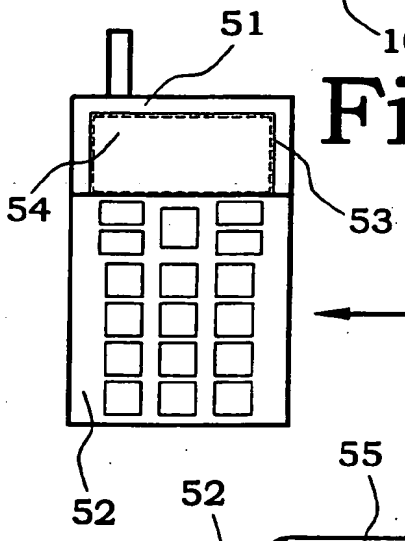


Fig. 4a

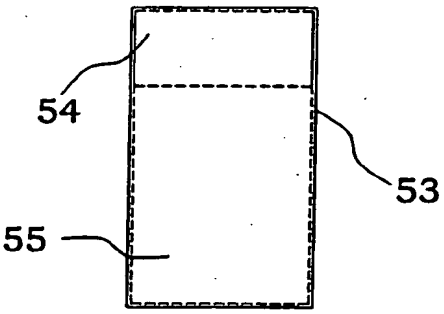


Fig. 4c

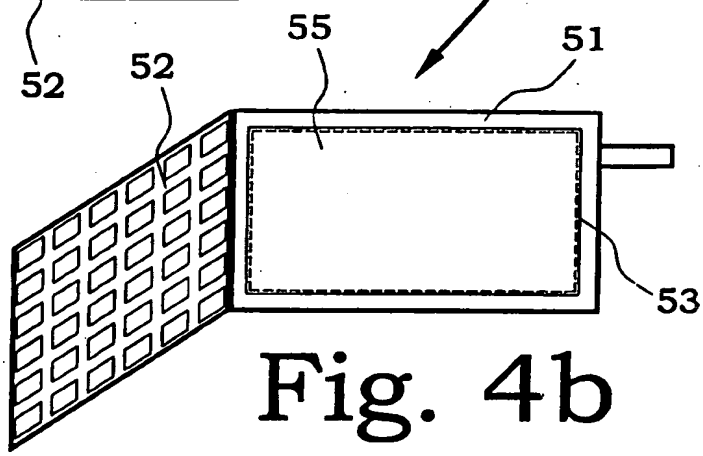


Fig. 4b

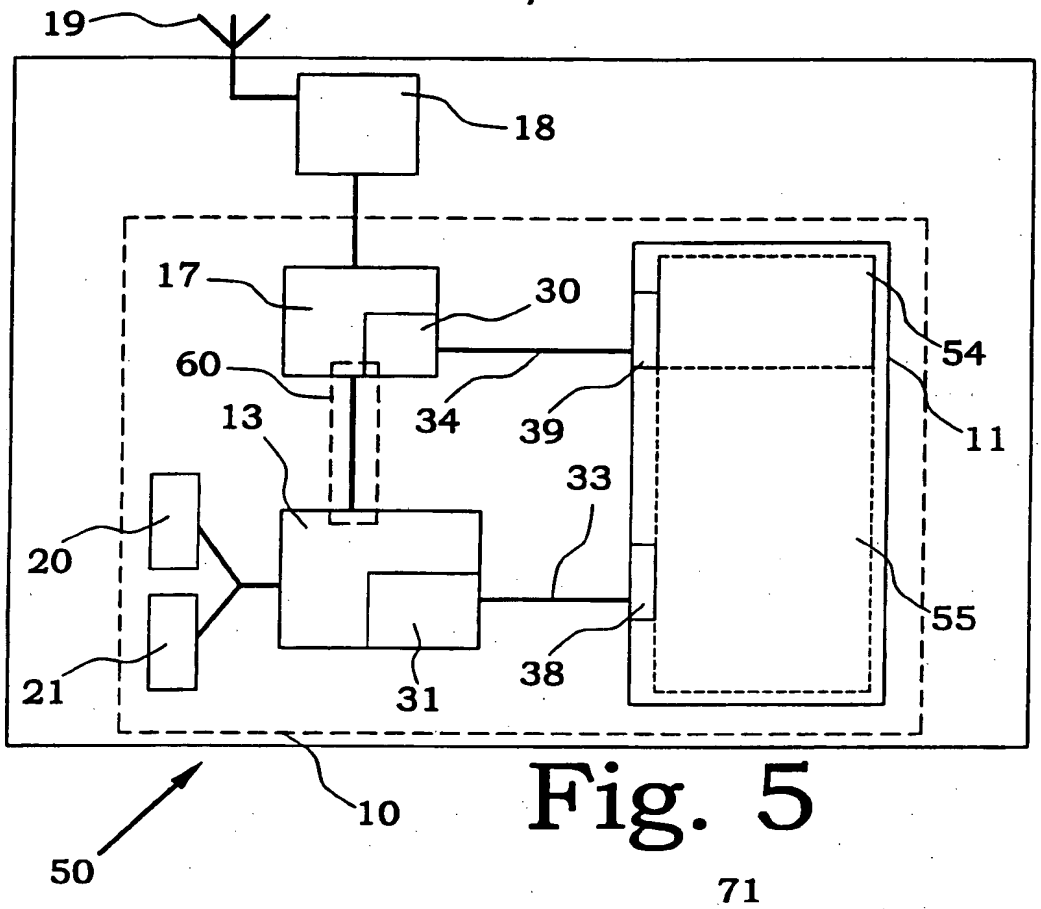


Fig. 5

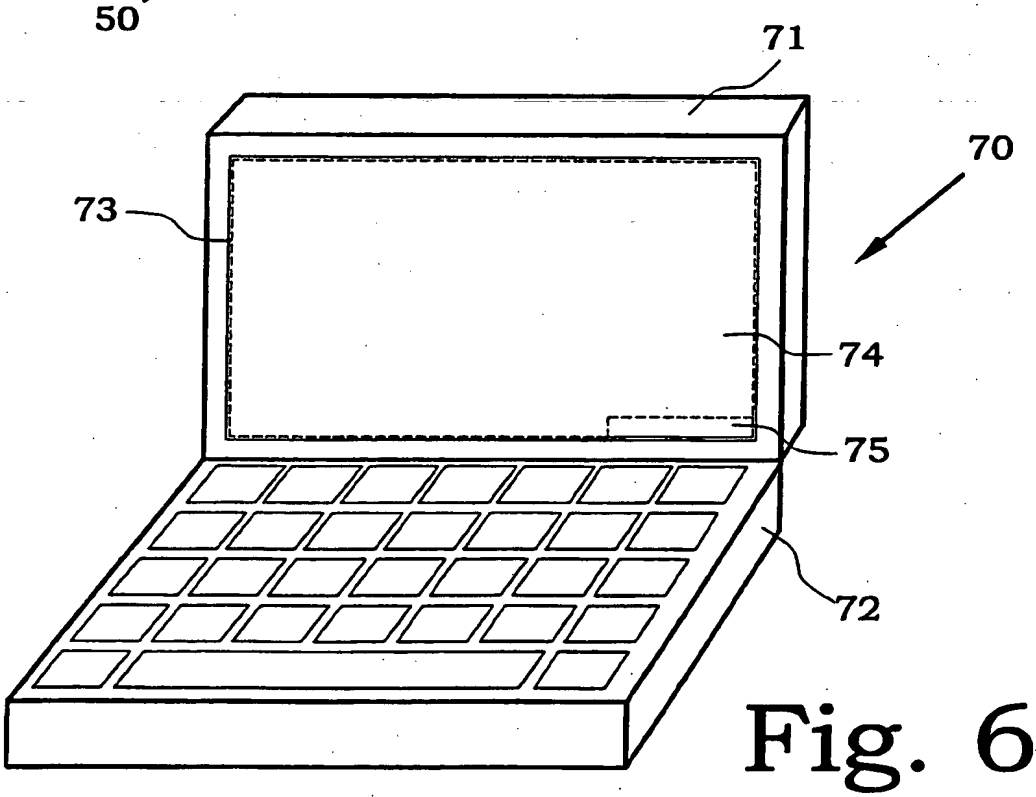


Fig. 6

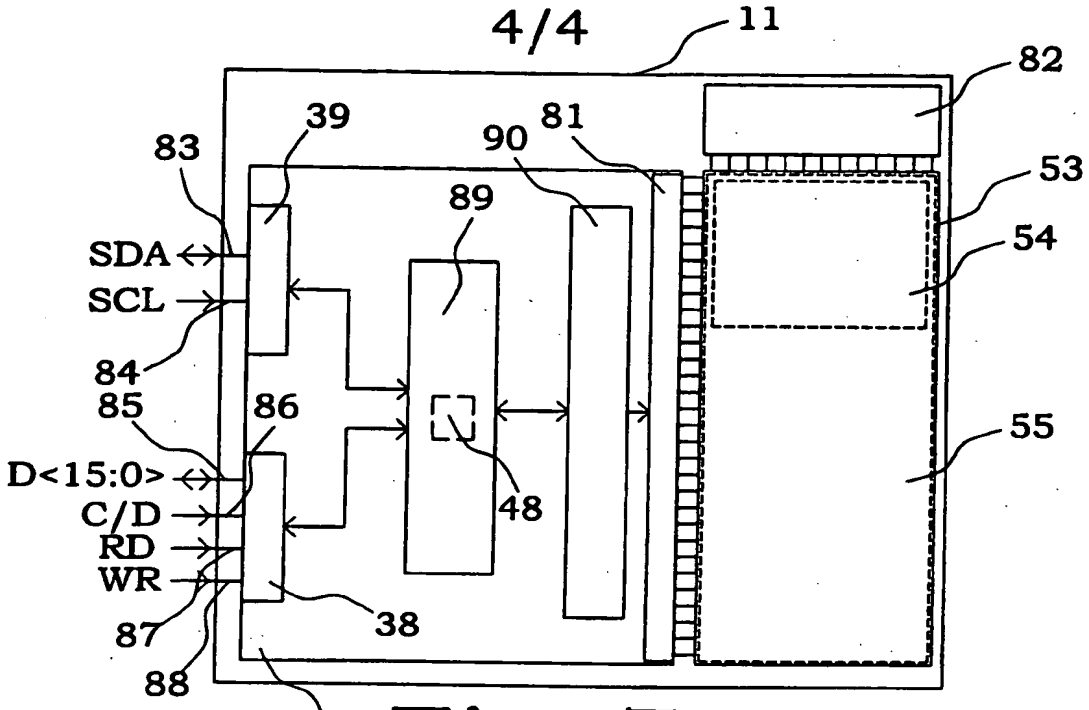

11
82
39
81
90
83
53
89
SDA
54
SCL
84
85
86
55
D<15:0>
48
C/D
RD
WR
38
87
88
80

Fig. 7

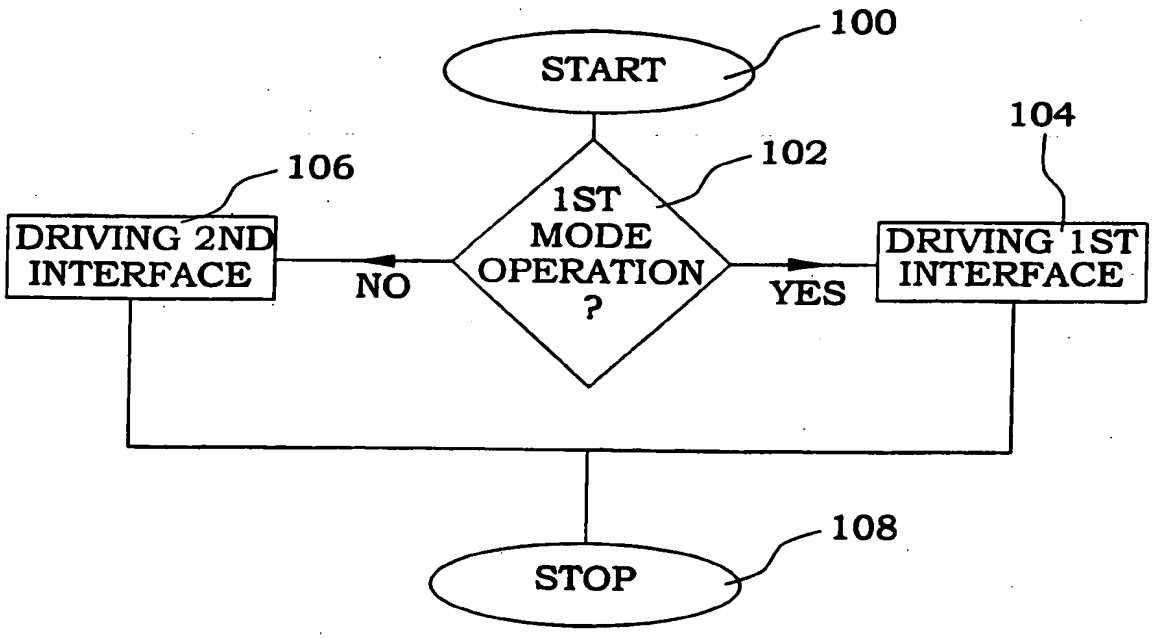

100
START
104
106
102
1ST MODE OPERATION ?
DRIVING 2ND INTERFACE
NO
YES
DRIVING 1ST INTERFACE
108
STOP

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/02179

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G09G 3/36, G06F 1/32
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G09G, G09F, G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5881299 A (H.NOMURA ET AL),9 March 1999 (09.03.99),column 3,line 48 - line 59; column 4,line 6 - line 17; column 4, line 24 -line 35, column 5,line 49 - 58,figure 1.	34-36
A	--	1-33
A	GB 2320591 A (JOHN QUENTIN PHILLIPPS), 24 June 1998 (24.06.98), page 3, line 6 - line 10; page 4, line 16 - line 29, figure 3	1-36
A	--	1-36
	EP 0743588 A1 (YIU,HING LEUNG), 20 November 1996 (20.11.96), column 2, line 39 - line 58, figure 1	
	--	

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 March 2001	08 -03- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ender Dag /itw Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/SE 00/02179

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2320591 A	24/06/98	GB 2320345 A,B	17/06/98
		GB 9625801 D	00/00/00
		GB 9803349 D	00/00/00
		US 6137481 A	24/10/00
EP 0743588 A1	20/11/96	US 5890799 A	06/04/99